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Review of the balantine genus *Udeina* Michaelsen, 1910 with descriptions of six new species in South Africa (Oligochaeta: Acanthodrilidae, Acanthodrilinae)

by

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ABSTRACT

A brief historical overview of the South African acanthodriline earthworms is given. The taxonomic position of the genus *Udeina* Michaelsen, 1910 is reviewed. An inclusion of the *Udeina* species, characterised by balantine arrangement of male reproductive organs in the genus *Parachilota* Pickford, 1937 as proposed by Ljungström (1969, 1972), is not accepted. *Udeina* is retained and redefined, and eleven species are now included. The indecisive status in the literature of two species, *U. kinbergi* (Michaelsen, 1899) and *U. reichei (*Ude, 1905), is discussed. New material of *U. reichei* has been studied, and the validity of both species confirmed. The type material of *U. montanus* Pickford, 1937, *U. pliskoae* Zicsi, 1998, and *U. stuckenbergi* Zicsi, 1998 was examined, and new observations, comments, and illustrations are provided. Six new species—*U. adriani, U. anneae, U. mapelane, U. nkandla, U. petrosi* and *U. qudeni*—are described and illustrated.

Identification keys are provided to the currently recognised genera of South African Acanthodrilinae and to species of *Udeina*.

The species name *U. stuckenbergeri* erroneously published by Zicsi (1998) is corrected to *U. stuckenbergi*.

INTRODUCTION

Although Pickford (1937), Ljungström (1969, 1972), Zicsi & Pajor (1992), and Zicsi (1998) have supplied considerable data on acanthodriline diversity in this country, the indigenous South African species still require substantial study. The known Acanthodrilinae are probably only a minor part of those that may be discovered. The present paper forms a part of a survey of acanthodrilines in South Africa, based on the collection in the Natal Museum.

For those Acanthodrilinae monographed by Pickford (1937), features of the male reproductive organs were used to separate genera: 1/ the primitive, acanthodriline arrangement of paired prostatic and male pores; 2/ microscolecine and balantine arrangements manifesting reductions in the number of prostates, and relocation of prostatic and male pores. The morphological nephridial differentiations, described as vesiculate or avesiculate, have been recognised as supportive diagnostic characters separating vesiculate microscolecine species from avesiculate balantine species. For all the acanthodrilines recorded from South Africa, the majority being indigenous species, five genera have been proposed: *Eodrilus* Michaelsen, 1907, *Chilota* Michaelsen, 1899*b*, *Microscolex* Rosa, 1887, *Parachilota* Pickford, 1937, and *Udeina* Michaelsen, 1910. Gates (1959) and Ljungström (1969, 1972) disagreed with the separation of the proandric, avesiculate, balantine species from proandric, avesiculate acanthodriline *Parachilota* species, suggesting that the balantine reductions might be only variations occurring in those *Parachilota* species characterised by more primitive acanthodriline male reproductive organ arrangements. Zicsi (1998) did not follow their suggestion, recognising the genus *Udeina* for the avesiculate species with the balantine prostatic reduction, known only from South Africa. This supported his interpretation that the genus *Yagansia*, Michaelsen, 1899 is accepted for those South American vesiculate species with microscolecine prostatic reduction. In the present paper, the validity of *Udeina* is recognised for South African species, and supported by additional evaluation of its generic features, notably the proandric condition associated with reductions to one pair of spermathecae and one pair of prostates, and constant occurrence of these characters.

The taxonomy proposed by Pickford (1937) is accepted here, although following Zicsi's (1998) recommendation, the South African species assigned by her to *Eodrilus* are accepted in *Eodriloides* Zicsi, 1998, supported by similar exclusion of Australian species, including the type-species *Eodrilus cornigrave* Michaelsen, 1907, from Western Australia, by Jamieson and Dyne (1976). The present paper comprises new taxonomic observations, evaluation of characteristics of the genus *Udeina*, and descriptions of six new species.

MATERIAL AND METHODS

During my extended survey of earthworms in South Africa, a collection of acanthodrilines was assembled, and specimens with balantine reductions of the anterior or posterior pair of prostates were noted. An additional substantial material of acanthodrilines donated to the Natal Museum by Dr A. J. Armstrong of the Biodiversity Division, Ezemvelo KZN Wildlife, and by the Mammal Research Institute, University of Pretoria, supplied more individuals with these characters. This stimulated my attention to evaluate South African proandric species, characterised by only one pair of spermathecae, balantine reduction of one pair of prostatic glands, and relocation of male pores.

The type material of known species *Udeina montanus* Pickford, 1937, *U. stuckenbergi* Zicsi, 1998, and *U. pliskoae* Zicsi, 1998, was included. No type material of *U. kinbergi* (Michaelsen, 1899) and *U. reichei* (Ude, 1905) has been examined. The types of both species were restudied by Michaelsen (1907, 1910, 1912) and Pickford (1937). Both authors confirmed that although the material was in poor condition, balantine reductions were evident. However, the exact locations of prostatic and male pores in the types remain uncertain, as neither author could definitely locate them, and probably further examination could be uninformative due to decomposition of the specimens.

A small sample containing two slightly decomposed adults and seven juveniles, collected on a bank of the Vaal River, possibly near the type locality of *U. reichei*, and identified by Ljungström (1972) as *U. kinbergi*, was examined by me and found to be *U. reichei*.

The types of new species described below—*U. adriani*, *U. anneae*, *U. mapelane*, *U. nkandla*, *U. petrosi*, and *U. qudeni*—and of already described *U. pliskoae* and *U. stuckenbergi*, are preserved in 75% ethanol and housed in the Natal Museum. *U. montanus* is in the South African Museum, Cape Town, South Africa. The descriptions of all species are based on type specimens, and comparisons with available additional material are made. Description of colour is based on specimens which may have lost intensity during preservation and through storage in alcohol or formalin. The number of body segments was counted from the anterior segment in which the prostomium is located, and presented in Arabic numerals. Intersegments and septa location are designated by a slash (e.g. 7/8). Dorsal longitudinal dissections were performed for study of the internal anatomy, and the photographs were taken under a Wild stereo microscope Type 181300. Penial setae were observed in glycerol jelly, permanently mounted in Berlese fluid, and photographed using photo-camera Wild MPS 51 attached to Wild Heerbrugg microscope.

Locality data and biological notes were taken from labels; information on the biotopes was often extended by personal comments from Dr A. J. Armstrong, or taken from Pooley and Player (1995). The species *U. adriani*, *U. mapelane*, *U. nkandla*, *U. petrosi*, *U. qudeni* and *U. stuckenbergi* are known from relatively undisturbed locations, suggesting that South African acanthodriline earthworms prefer pristine, natural biotopes, indigenous grasslands and forests. Probably more species will be found in other protected areas of South Africa.

Generic characters of South African Acanthodrilinae reported by Pickford (1937) are presented in Table 1. Keys are provided to recognised genera of South African Acanthodrilinae and to the species of *Udeina*.

Glossary, abbreviations and definitions of terms used in the text:

1/*n* immediately followed by a figure refers to that part of segment covered by clitellar tissue.

TABLE 1

Generic characters of South African acanthodriline earthworms presented by Pickford (1937).

Genus	*Microscolex*	*Eodrilus= Eodriloides*	*Chilota*	*Parachilota*	*Udeina*
Spermiductal/ testes funnels	holandric, or proandric with rudimentary funnels in 11	holandric	proandric	proandric	proandric
Spermathecae	one pair, or two pairs, or absent	two pairs	two pairs	two pairs	one pair
Spermathecal pores	7/8 and 8/9; or 7/8 or 8/9; or absent	7/8 and 8/9	7/8 and 8/9	7/8 and 8/9, or on the anterior part of 8 and 9	7/8
Male pores	17 or 18 or absent	18 or 17/18	18	18 or 19	17 or 18
Prostates	one pair, or two pairs, or absent	two pairs	two pairs	two pairs	one pair
Prostatic pores	17 and 19	17 and 19	17 and 19	17 and 19, or 18 and 20	18 or 19
Male repro ductive organs	microscolecine	acanthodriline	acanthodriline	acanthodriline	balantine
Excretory system	vesiculate	avesiculate	vesiculate	avesiculate	avesiculate
Indigenous to SA	one species	15 species	13 species	52 species	two species
Introduced to SA	two species	none	none	none	none

Acanthodriline arrangement of the male reproductive organs, or shortened as one word: acanthodriline – refers to location of two pairs of prostatic pores of the tubular prostates in segments 17 and 19 respectively, and male pores present in segment 18. This condition is usually associated with two pairs of spermathecae, and spermathecal pores occurring in intersegmental furrows 7/8 and 8/9 respectively. This arrangement is considered as primitive in the Acanthodrilidae.

Avesiculate – referring to a holoic single nephridium without dilation. The term was used by Pickford (1937) to describe the nephridia observed in acanthodriline species allocated to *Eodriloides*, *Parachilota* and *Udeina*.

Balantine – originally the term referred to a reduction of anterior pair of prostates and posterior pair of spermathecae, occurring in species characterised by acanthodriline condition; one pair of prostates occurs in segment 19, and a pair of spermathecae of segment 8 has its pores located in intersegmental furrow 7/8. The present understanding employed in this paper, refers to acanthodriline, avesiculate species, with one pair of prostates, with prostatic pores in 17 or 18 or 19, and with one pair of spermathecae with spermathecal pores in intersegmental furrow 7/8 or 8/9. Male pores may occur in 16 or 17 or 17/18 or 18.

Clitellum – the region of the body-wall formed from glandular cells, which secrete material to form a cocoon. It may be saddle-shaped or ring-shaped, although the shape may depend on the phase of sexual maturity. The position of clitellum in most South African Acanthodrilinae species is usually constant, but intraspecific variation occurs in some species.

Figures followed by a stroke (for example 7/8) indicate a position between segments or septa.

Holandric – refers to number and position of testes and testes funnels; indicates presence of two pairs of testes and two spermiductal funnels occurring in segments 10 and 11 respectively; (compare proandric).

Holoic – (old terms: holonephric or meganephric); refers to the paired excretory organs, as simple nephridia in each segment of the body except the pharyngeal segments. Holoic nephridia are observed in all acanthodrilids. Pickford (1937) noted in some species that the single nephridium may possess variable dilation forming terminal bladders, and on this basis, for the species recorded in South Africa, two groups were established: the avesiculate nephridia found in *Eodriloides*, *Parachilota* and *Udeina*, and the vesiculate nephridia in *Chilota* and *Microscolex*.

JDP – J. D. Plisko.

KZN – KwaZulu-Natal province of South Africa.

Male pores – ectal ends of vasa deferentia. In majority of the South African acanthodrilines male pores are situated laterally to the *b* setae; only in two known species (*P. vanhoffeni* and *P. bavenda*) approximating towards the mid-ventral line. In some species may be fused with prostatic pores.

Microscolecine – originally this term referred to a reduction of posterior pair of prostates and reduction of anterior pair of spermathecae, observed in the species with acanthodriline male reproductive organs. In the vesiculate species recorded in South Africa, the microscolecine characters have been observed only in two introduced, and in one endemic species. Variability in reduction and relocation of male organs were noted.

NMSA – Natal Museum, Pietermaritzburg, South Africa.

Penial seta (pl. penial setae) – specialised seta associated with prostatic pore; development of penial seta depends on maturation of the individual; after the sexual phase, the well developed seta is discharged, being gradually replaced by a new precursory seta, which is progressively modified. During seta formation, precursory setae come to resemble the adult penial setae except in size, and their shapes may be observed. In the majority of known South African acanthodrilines, the penial setae were observed and often described; however, the state of their maturity was not always indicated. The taxonomic importance of penial setae is considerable.

Penial setal retractor muscles (pl. retractors) – the muscles originating from the body wall dorso-laterally, usually behind the penial seta and activating them; maturity of retractors depends on maturation of individuals. The site of origin can be of taxonomic value.

Proandric – refers to number and position of testes and their funnels; indicates the presence of a single pair of testes and spermiductal funnels in segment 10; (compare holandric).

Prostate (pl. prostates) – paired glands associated with male reproductive organs; each consists of a prostatic gland and muscular prostatic duct. In most Acanthodrilidae the prostatic gland is tubular; according to Pickford (1937), it originates as an ectodermal invagination lateral to seta *b*; the number and position correspond to the number and position of prostatic pores, and for acanthodrilids it is an important taxonomic character. In South African species always tubular.

Prostatic duct – extended part of prostatic gland, usually muscular; its ectal part opens into prostatic pore.

Prostatic gland – in South African Acanthodrilinae, the glandular, tubular part of prostate; may be confined to one segment or extended through several segments.

Prostatic pore (pl. prostatic pores) – ectal part of prostatic duct. In the endemic South African acanthodrilines the pores are situated lateral to the *b* setae; only in two species (*P. vanhoffeni* and *P. bavenda*) the prostatic pores approach the mid-ventral line. South African indigenous mature specimens usually have the pores connected with the male pores by the seminal grooves.

Salivary glands – pharyngeal structures; in South African acanthodrilines usually extending backwards to septum 4/5, however, in some species slightly beyond.

Segment – the primary unit of segmentation; a portion of the body internally separated by septa, externally by intersegmental furrows. In most South African acanthodriline species segmentation corresponds to external and internal transverse metameric divisions, in clear distinction to indigenous microchaetids, where external annulation is not congruent with internal divisions.

Seminal grooves – external elongated depressions connecting male pores with prostatic pores.

Seminal vesicle (pl. seminal vesicles) – a part of male reproductive organs; a pocket formed from dilated septum, where the sperm is matured.

Septum (pl. septa) – an internal transverse wall between segments, acting as a supporting membrane for internal organs; usually delicate, although in some anterior segments thickened to varying degrees. In the South African species its nature is a supportive taxonomic character.

Seta (pl. setae) – any chitinous bristle, being a product of a single ectodermal cell at the end of a tubular epidermal ingrowth. Setal formula is expressed in small letters: *a* = the most ventral seta; *b* = the seta next lateral to *a*; *c* = the seta next lateral to *b*; *d* = the seta next lateral to *c*; *aa* = median space ventrally between the two setae; *ab* = space between *a* and *b*; *bc* = space between *b* and *c* setae; *cd* = space between *c* and *d* setae; *dd* = space between the most dorsal setae. In the vast majority of the endemic South African acanthodrilines setae are widely paired; it is not confirmed whether the inter-setal ratio, often being variable, can be applied for taxonomic evaluation.

Spermatheca (pl. spermathecae) – an organ in which sperm received from a copulatory partner is stored. Each consists of the ampulla, duct, and diverticulum. The ampulla, usually largest part of the spermatheca, is more or less ovoid, and thin-walled. The duct is variable in shape and size, communicates by its ental part with the ampulla, and through its ectal part with spermiductal pore. The diverticulum can be simple or bi- or multiple-branched, variously shaped; its size and shape are of great taxonomic importance. In South African endemic acanthodrilines, sperm is usually stored in the diverticulum, sometimes also partly in the duct, but has not been observed in the ampulla. The number, position and shape of spermathecae are primary taxonomic characters.

Spermathecal pores – external openings at ends of ectal parts of spermathecae. Their number and position are of high taxonomical importance.

Spermiductal funnel = testes funnel (pl. spermiductal funnels) – the ental part of sperm duct through which sperm pass from testes into lumen of vas deferens on the way to male pore.

U – circumference of the body; in South African Acanthodrilinae the distance between *dd* is variable.

Vas deferens (pl. vasa deferentia) – the sperm duct carrying the sperm from the spermiductal funnel towards the male pore.

Vesiculate – a holoic single nephridium, variable in size and shape of dilation forming terminal bladder (a vesicle). A term used by Pickford (1937) for nephridia observed in the species of *Chilota* and *Microscolex.*

TAXONOMY

Key to genera of the subfamily Acanthodrilinae known in South Africa

1 Holandric 2

– Proandric 3

2 Excretory system holoic, avesiculate. Male reproductive organs acanthodriline. Two pairs of spermathecae; two pairs of spermathecal pores; each pair in intersegmental furrow 7/8 and 8/9. One pair of male pores in segment 18, or in intersegmental furrow 17/18. Two pairs of prostatic pores; each pair in segment 17 and 19. Gizzard in segment 5; rudimentary, moderately or well developed. Spermathecal, prostatic pores and male pores not approximate towards the mid-ventral line ....
Eodriloides Zicsi, 1998

– Excretory system holoic, vesiculate. Male reproductive organs microscolecine, variable. One or two pairs of spermathecae, or spermathecae absent; one pair of spermathecal pores in intersegmental furrow 7/8 or 8/9, or two pairs, each in segment

7/8 and 8/9, sometimes absent. One pair of male pores in segment 17 or 18, or absent. One pair of prostatic pores in segment 17, or two pairs, each in 17 and 19. Male pores might be fused with prostatic pores or enter independently. Gizzard in segment 5, rudimentary. In introduced species, a posterior pair of spermiductal funnels might be reduced, or occurs in rudimentary parts. Spermathecal, prostatic pores and male pores not approximate towards the mid-ventral line ....
Microscolex Rosa, 1887

3 Excretory system holoic, vesiculate. Male reproductive organs acanthodriline. Two pairs of spermathecae. Two pairs of spermathecal pores; each pair in intersegmental furrow 7/8 and 8/9. One pair of male pores; male pores in segment 18. Two pairs of prostatic pores; a pair in segment 17 and 19. Gizzard reduced, if present in segment 5, rudimentary or well developed. Spermathecal, prostatic pores and male pores not approximate towards the mid-ventral line .... *Chilota* Michaelsen, 1899

– Excretory system holoic, avesiculate 4

4 Male reproductive organs acanthodriline. Spermathecal, prostatic pores and male pores not approximate towards the mid-ventral line, or situated close to the mid-ventral line. Two pairs of spermathecae. Two pairs of spermathecal pores; each pair in intersegmental furrow 7/8 and 8/9, or on the anterior border of segment 8 and 9. One pair of male pores in segment 18 or 19. Two pairs of prostates; two pairs of prostatic pores, each pair in segment 17 and 19, or in 18 and 20. Gizzard in segment 5 or 6; rudimentary, or moderately or well developed ....
Parachilota Pickford, 1937

– Male reproductive organs balantine. Spermathecal, prostatic pores and male pores not approximating towards mid-ventral line. One pair of spermathecae in 8 or 9. Spermathecal pores in 7/8 or 8/9. One pair of male pores in segment 16 or 17 or 18, or in intersegmental furrow 17/18; in front or behind of prostatic pores, separated, or fused with prostatic pores. One pair of prostatic pores in segment 17 or 18 or 19. One pair of well developed prostates, or one pair of well developed prostates and rudimentary prostatic ducts in segment 17 .... *Udeina* Michaelsen, 1910

Udeina Michaelsen, 1910 emend.

Holoscolex Ude, 1905: 421 (preoccupied by Cognetti 1904).
Yagansia [partim]: Michaelsen 1899*a*: 237.
Udeina Michaelsen, 1910: 53, 1912: 4, 5; Stephenson 1930: 671, 828; Pickford 1937: 416; Gates 1959: 239; Reynolds & Cook 1976: 62.
Udeina [applied for *Parachilota*]: Ljungström 1969: 370.
Udeina [partim]: Ljungström 1972: 100.
Udeina Michaelsen, 1890 [sic] Zicsi 1998: 67.

Type species: *Yagansia kinbergi* Michaelsen, 1899*a*: 443.

Revised diagnosis: Setae lumbricine. Prostomium tanylobous. Prostatic pores and male pores not approximating towards the mid-ventral line. Prostates tubular. Proandric. Holoic, avesiculate. One pair of spermathecae in segment 8 or 9. Spermathecal pores in intersegmental furrow 7/8 or 8/9. One pair of male pores in segment 16 or 17 or 18 or in 17/18, in front or behind of prostatic pores, separated or fused with prostatic pores. One pair of prostatic pores in segment 17 or 18 or 19. One pair of well-developed prostates, or with additional vestigial parts of second prostatic pair. Spermathecal diverticulum uni- or bilobate. Gizzard variably developed in segment 5. Typhlosole absent. Calciferous glands absent.

Distribution: Endemic to South Africa. Known from Free State, North West province, Western Cape, Eastern Cape, KZN.

Remarks and historical notes: The first species described with balantine features was *Yagansia kinbergi*, collected over 150 years ago; the type locality was cited as 'Caffraria' or 'Kaffraria', possibly a part of western KZN extending into eastern Free State. A single specimen, not clitellate, broken in two pieces, was described by Michaelsen (1899*a*); subsequently it was restudied by Michaelsen (1907, 1910, 1912), and by Ude (1905) who described the new genus *Holoscolex* for the new species *reichei*. Ude (1905) compared these two species, both similarly characterised by balantine male reproductive organs. However, no final clarification of the exact position of the male and prostatic pores was stated. Michaelsen (1910), accepting the generic status suggested by Ude for balantine species known from South Africa, proposed the new generic name *Udeina* for *Holoscolex* because it was preoccupied. Subsequently, Michaelsen (1912) synonymised *reichei* under *kinbergi*, stating: '*Gen.* Holoscolex *Ude: da dieser Name von Cognetti schon eine Glossoscolecinen-Gattung vergeben ist, so bedarf die Udesche Acanthodrilinen-Gattung einer anderen Bezeichnung. Ich nenne sie* Udeina, *Typus:* U. kinbergi *(Mich.)* = Yagansia Kinbergi *Mich.* = Holoscolex Reichei *Ude.'* To this, Michaelsen also added information on the type locality, suggesting it was in the Free State. In the same paper he wrote: '…*Südafrika, etwa von der Breite der Kalahari südwärts, charakterisiert durch die Microchätinen-Gattungen* Microchaetus *und* Tritogenia, *sowie durch die Acanthodrilinen-Gattungen* Chilota *und* Udeina'. Pickford (1937) also synonymised *U. reichei* with *U. kinbergi*. Zicsi (1998), however, considered that *U. reichei* may be a valid species, based on examination of material collected by himself in the area of Parys on a bank of the Vaal River in the Free State.

The third species with balantine features is *Udeina montanus* Pickford, 1937 described from a small sample from the Langeberg range in the Western Cape, differing from *U. kinbergi* in many characters (location of prostatic and male pores, fused or separated prostatic and male ducts, number of hearts). This species was accepted as more primitive than *U. kinbergi*. An independent evolution of both species from different *Parachilota* species was suggested. The species added by Zicsi (1998), *U. pliskoae* and *U. stuckenbergi*, and six new species described in this paper—*U. adriani, U. anneae, U. mapelane, U. nkandla, U. petrosi,* and *U. qudeni*—have raised the number of balantine species to eleven. All being proandric, with holoic avesiculate nephridia, having only one pair of spermathecae and one pair of prostatic pores, belong evidently to one species-group, with the balantine condition characterising *Udeina*. It has been found that the position of the spermathecal pores, male pores, and prostatic pores, are variable within the genus (Table 2). However, the reduction of one prostatic pair, either the anterior or posterior one, is evidently associated with the reduction of one pair of spermathecae and relocation of male pores. The prostatic pores can occur anteriorly or posteriorly to male pores, or be on the same segment as male pores. The ectal parts of the vasa deferentia can enter into the male pores separately, or be fused with ectal parts of prostatic pores. The presence of vestigial parts of the second pair of prostatic ducts observed in *U. petrosi* may suggest stages in prostate reduction. It is noteworthy that a reduction of

TABLE 2

Selected characters used for the *Udeina* species separation.

Species name	Spermathecal pores	Male pores pores	Prostatic pores	Intestine	Last pair of hearts	Diverticulum
adriani	7/8	18	19	16	12	unilobate
anneae	7/8	18	19	17	13	unilobate
kinbergi	7/8	17	18	16	13	unilobate
mapelane	7/8	18	17	16	12	unilobate
montanus	7/8	18	19	17	12	unilobate
nkandla	7/8	17/18	17	16	12	bilobate
petrosi	7/8	18	19	16	12	bilobate
pliskoae	7/8	18	17	16	12	unilobate
qudeni	7/8	16	17	15	12	unilobate
reichei	7/8	17	18	17	13	unilobate
stuckenbergi	8/9	17	17	17	12	unilobate

one pair of prostates, or relocation of prostatic pores or male pores, are variable in the species currently grouped in *Udeina*; however, this variability was noted in populations of *U. anneae*, *U. mapelane*, *U. montanus*, *U. petrosi*, *U. pliskoae*, and *U. stuckenbergi*. A similar reduction of the anterior prostatic pair to vestigial prostatic ducts, was observed in three dissected specimens of *U. petrosi*.

Key to species of the genus *Udeina* Michaelsen, 1910

1 Spermathecal pores in intersegmental furrow 7/8 2
– Spermathecal pores in intersegmental furrow 8/9 .... **stuckenbergi** Zicsi, 1998

2 Prostatic pores in segment 17 or 18 3
– Prostatic pores in segment 19; male pores in 18 7

3 Prostatic pores in segment 17 4
– Prostatic pores in segment 18; male pores in 17; last pair of hearts in 13.......... 10

4 Male pores in 16 or in 17/18 5
– Male pores in 18 6

5 Male pores in segment 16; intestine commences in 15; last pair of hearts in 12 ... **qudeni** sp. n.
– Male pores in intersegmental furrow 17/18; intestine commences in 16; last pair of hearts in 12; spermathecal diverticulum bilobate .... **nkandla** sp. n.

6 Spermiductal funnels free; spermathecal duct extended; spermathecal diverticulum large, attached with duct below ampulla; intestine commences in segment 16; last pair of hearts in 12 .... **mapelane** sp. n.
– Spermiductal funnels enclosed; spermathecal duct short; spermathecal diverticulum attached to duct at its base; intestine commences in segment 16; last pair of hearts in 12 .... **pliskoae** Zicsi, 1998

7 Intestine commences in 16 8
– Intestine commences in 17 9

8 one pair of prostates in segments 17–21; last pair of hearts in 12; spermathecal diverticulum unilobate .... **adriani** sp. n.

– One pair of prostates in segment 19, and additional vestigial parts of prostatic ducts in segment 17; spermathecal diverticulum bilobate .... **petrosi** sp. n.

9 Last pair of hearts in segment 12; spermathecal diverticulum unilobate .... **montanus** Pickford, 1937

– Last pair of hearts in 13; spermathecal diverticulum unilobate .... **anneae** sp. n.

10 Intestine commences in 16 .... **kinbergi** (Michaelsen, 1899)

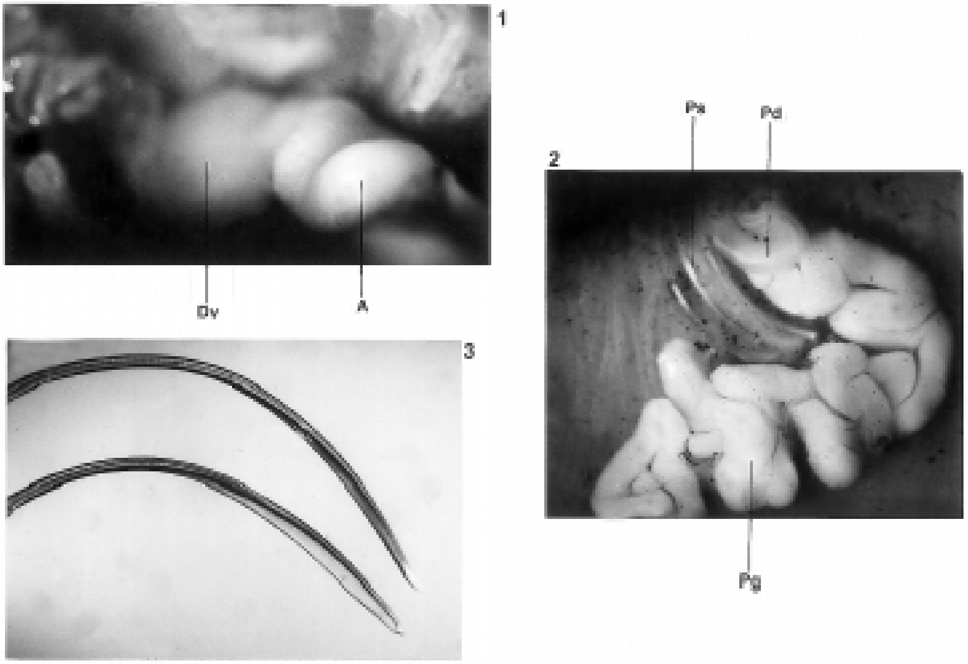
– Intestine commences in 17; last pair of hearts in segment 13 .... **reichei** (Ude, 1905)

Udeina adriani sp. n.

Figs 1–3

Etymology: Named in honour of Dr Adrian J. Armstrong of Ezemvelo KZN Wildlife, who supported research on Acanthodrilinae in KZN, and collected this species.

Type material: Holotype: clitellate NMSA/Olig.03622 *KwaZulu-Natal*: Drakensberg, section of Giant's Castle Game Reserve, Injasuthi [new spelling: Inijasuthi] (29º06'50.671"S:29º26'33.834"E), opposite camp, hillside at approx. 1540 m at south-facing slope, wooded grassland at edge of dry drainage in *Protea* savannah, 2–10 cm below surface, among roots of medium-tall *Themeda* grass, 14 June 2002, A. J. Armstrong.



Figs 1–3. *Udeina adriani* sp. n. 1. Holotype. Right spermatheca, extended, 400 X. A = ampulla; Dv = diverticulum. 2. Left prostate, 180 X. Pg = prostatic gland; Pd = prostatic duct; Ps = penial seta. 3. Ectal parts of penial setae, 500 X.

Description:

External features:

Body cylindrical, 100 mm long, 5 mm wide at segment 10, 4 mm posteriorly, in life and freshly alcohol-preserved, dorsally violet up to middle of the body length, violet colouration extending to *c* setae; last three segments also pigmented; ventrally yellowish-grey. Colouration fading after preservation. *Segment number*: holotype 147. *Prostomium*: tanylobous with distinct sutures. *Setae*: widely paired; postclitellarly *ab* = *cd*; *aa* > *cd*. *Dorsal pores*: not observed. *Nephridial pores*: externally noted only in intersegmental furrows 20/21–27/28. *Spermathecal pores*: in intersegmental furrow 7/8, ventro-laterally, in front of *b* setae on small swellings. *Female pores*: paired, in 14, in front of *a* setae. *Clitellum*: saddle-shaped, on 13–17; ventral edges extending to *b* setal lines. *Prostatic pores*: ventro-laterally, in 19 near *b* setae, encircled by small swollen papillae. *Male pores*: probably in 18, laterally to *b* setae, where externally are tiny openings; internally not confirmed. *Seminal grooves*: not observed. *Papillae*: not observed.

Internal characters:

Salivary glands: do not extend backwards beyond septum 4/5. *Gizzard*: well developed, in segment 5, cylindrical, muscular, preceded by enlarged pharyngeal, soft structure in segment 4. *Septa*: 4/5–5/6 thin, 6/7–14/15 thickened, increasing in thickness to 10/11, then decreasing; other septa thin. *Intestine*: commences in 16. *Lateral hearts*: four pairs, last pair in 12. *Nephridia*: elongated, coiled loops without terminal vesicles, anteriorly large, posteriorly smaller. *Ovaries*: in 13, covered by thick body-wall tissues. *Testes* and *spermiductal funnels*: spermiductal funnels free, small, iridescent, ventrally in segment 10. *Vasa deferentia*: observed only in 10 and 11, posteriorly covered by thick tissues of body wall; ectal parts not observed, and connection with male pores not confirmed. *Seminal vesicles*: two pairs, differing in shape and size; anterior pair in 9, minute, closely attached medially to septum 9/10; in 11 moderate, lobulate, dorso-lateral. *Spermathecae* (Fig. 1): in 8, moderate in size; ampulla elongated, initially closely attached to cuplike unilobate diverticulum, extending into oval bladder, connected with ectal part of duct in intersegmental furrow 7/8; shape of contracted spermatheca slightly resembles an acorn. *Prostates* (Fig. 2): one pair, well developed. Prostatic gland long, multi-folded, coiled and looped, passing irregularly backwards and forwards through segments 17–21; thin septa of those segments partly pierced, possibly by prostatic gland. Prostatic duct, much thinner than prostatic gland, muscular, double curved, attached with prostatic gland laterally in middle of 19, entering into prostatic pores in 19. *Penial setae* (Figs 2, 3): large, curved, not ornamented, ends slightly broadened and sharpened. *Penial setal retractor muscles*: originate from body wall near septum 20/21.

Biological notes and distribution: The holotype was collected during early winter in the Giant's Castle Game Reserve, in Drakensberg foothills. The whole reserve has been for nearly 100 years under environmental protection, presently by Ezemvelo KZN Wildlife. Iridescent spermiductal funnels indicate maturity. Associated with the microchaetid *Proandricus amphius* Plisko, 2003.

Discussion: *U. adriani* agrees with earlier proposed generic definitions (Ude 1905; Michaelsen 1910; Pickford 1937). It is most similar to *U. montanus*, having prostatic pores in segment 19, male pores in 18 probably being fused with prostatic pores, and last pair of lateral hearts in segment 12. It differs in its general appearance, pigmentation, size, commencement of intestine, and shape of spermathecae. *U. montanus* is known from Langeberg mountain range in Western Cape, and Pickford (1937) noted its similarity to *U. kinbergi*. However, it is difficult to establish relationships between these species, because differences in other characters are evident.

Udeina anneae sp. n.

Figs 4–6

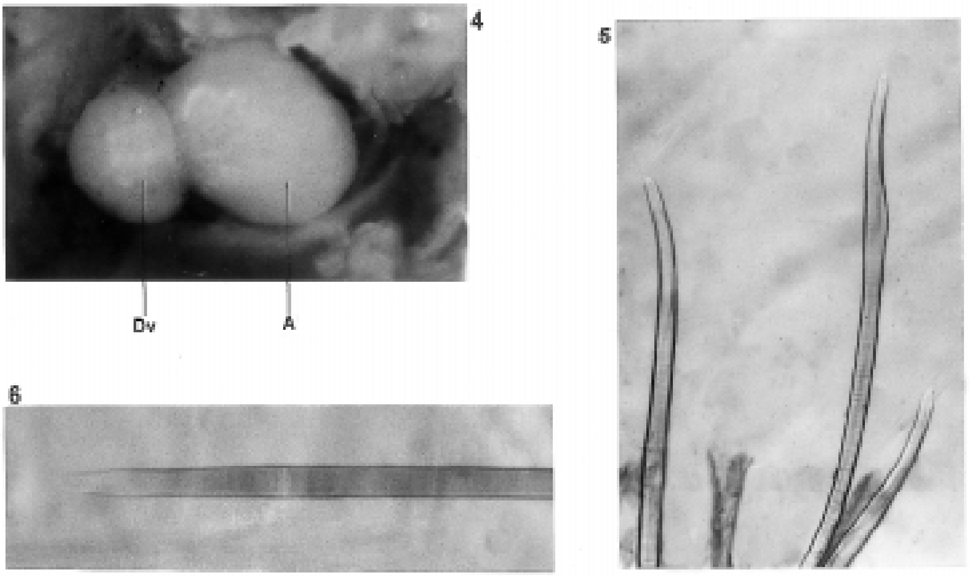
Etymology: Named after my friend Mrs Anne Blaylock.

Type material: Holotype: mature, with clitellum marked by brownish colouring, NMSA/Olig.02032 *KwaZulu-Natal*: Kranskop (29°59'S:30°53'E) indigenous forest, from litter and first layer of moist soil, 12 December 1994, JDP & B. R. Stuckenberg. Paratype: NMSA/Olig.03638, 1 specimen in similar state of development, collected with holotype.

Description:

External features:

Body cylindrical, after long preservation in alcohol dorsally violet along whole body length, slightly fading behind segment 107, last 7 segments circularly violet; laterally colouring extends to *c* setae; ventrally yellowish-grey. Holotype 107 mm long, 5 mm wide; paratype 85 mm long, 4 mm wide. *Segment number*: holotype and paratype 157. *Prostomium*: tanylobous with deep sutures. *Setae*: large, widely paired; *aa* > *ab*; *ab* < *bc*; *aa* = *bc*; distance between *ab* decreasing slightly on 15–18, increasing on 19–25, posteriorly even. *Dorsal pores*: not observed. *Nephridial pores*: not observed. *Spermathecal pores*: in intersegmental furrow



Figs 4–6. *Udeina anneae* sp. n. Holotype. 4. Spermatheca, 500 X. A = ampulla; Dv = diverticulum. 5. Penial setae, juvenile, 400 X. 6. Ectal part of juvenile penial seta, 500 X.

7/8, ventro-laterally in front of *b* setae, on small swellings. *Female pores*: not observed externally. *Clitellum*: externally undeveloped, marked by brownish colouring, on 13–1/n18. *Prostatic pores*: ventro-laterally, in 19, on small papillae near *b* setae. *Male pores*: not observed externally; probably in 18. *Seminal grooves*: not observed. *Papillae*: not observed.

Internal characters:

Salivary glands: large, not extending backwards beyond septum 4/5. *Gizzard*: moderately developed in segment 5, cylindrical, slightly muscular. *Septa*: 5/6–6/7 thin, conical, 7/8–15/16 much thickened; 7/8–11/12 increasing in thickness, 12/13–15/16 decreasing in thickness, much thinner than 11/12; other septa very thin. *Intestine*: commences in 17; oesophagus in 12–15 enlarged, soft, in 16 narrow. *Lateral hearts*: four pairs; last pair in 13. *Nephridia*: elongated coiled loops without terminal vesicles, large in anterior segments, posteriorly smaller. *Ovaries*: not observed. *Testes* and *spermiductal funnels*: spermiductal funnels free, ventrally in segment 10. *Vasa deferentia*: observed only in 10–11, in following segments covered by thick tissues of body wall; ectal parts not observed, and entry into male pores not established. *Seminal vesicles*: two pairs; in 9 and 11 respectively; anterior pair commencing laterally at septum 9/10, moderate, lobulated; posterior pair much larger, lobulated, commencing at septum 10/11 medially, extending dorsolaterally. *Spermathecae* (Fig. 4): in segment 8; ampulla large, ovoid, connected with wide duct at its anterior part. Diverticulum simple, globular, unilobate, attached to duct at its almost half length, terminating below ampulla. *Prostates*: one pair, well developed. Prostatic gland relatively narrow, multi-folded, looped, passing irregularly backwards through segments 19–21, partly piercing septa or shaping them conically. Prostatic duct commences as thin, coiled tube in segment 20, extends forward to 19, becoming much thicker, enters into prostatic pore in 19. It was not established if prostatic ectal parts are fused with vasa deferentia before entering body wall, or enter prostatic pores independently. *Penial setae* (Figs 5–6): four setae in bundle, possibly not all developed into mature state. Long approx. 3.8 mm, straight, slightly thinner and rounded at ectal parts. *Penial setal retractor muscles*: thin, commence at septum 19/20.

Biological notes and distribution: The two specimens were collected from litter in indigenous mistbelt forest. The site is a small, steep-sided valley adjacent to the road from neighbouring town of Kranskop. Degradation of the forest and pollution of the stream were evident. Both specimens have the clitellum marked only by brown colouring, externally without developed clitellar tissues, suggesting post-sexual state. No sperm was observed in the large, well developed, spermathecal diverticulum; iridescent spermiductal funnels and large seminal vesicles were present. The species was associated with the indigenous microchaetids *Proandricus setosus* Plisko, 1996, *Tritogenia insolita* Plisko, 1997, and *Tritogenia koilia* Plisko, 1997, and an introduced *Amynthas* sp. This species is known only from a fairly typical Afromontane mistbelt forest on the south side of the Thukela River in KZN.

Discussion: *U. anneae* is similar to *U. adriani* in having the prostatic pores in segment 19 and the male pores in 18, but differs in location of the last pair of lateral hearts, commencement of intestine, and shape of spermathecae. Penial setae are also different.

Udeina kinbergi (Michaelsen, 1899)

Yagansia kinbergi Michaelsen, 1899*a*: 443; 1900: 157; Reynolds & Cook 1976: 123.
Yagansia Kinbergi: Ude 1905: 424.
Holoscolex kinbergi: Michaelsen 1907: 32.
Udeina kinbergi: Michaelsen 1910: 53; Zicsi 1998: 68.
Udeina kinbergi: [partim] Pickford 1937: 416.
Holoscolex reichei: Pickford 1937: 416.
Udeina kinbergi: Ljungström 1972: 105 [misidentification of *reichei*].

No type or other material was examined.

Discussion: A single specimen, not clitellate, broken into two pieces, was described as the first species of *Udeina*. Due to its poor condition, knowledge of its external and internal characters is still unsatisfactory. Differing assessments of relationships of this species with *U. reichei* have been published (Ude 1905; Michaelsen 1907; Pickford 1937; Ljungström 1972), uncertainty remains, but validity of *kinbergi* is now accepted.

The type locality recorded by Wahlberg as ‘Caffraria’, and later translated by Michaelsen (1899*a*) as ‘Kafferlandet’, is difficult to identify. Pickford (1937), following advice of Dr O. Lundblad from Stockholm who was working on the material collected by Wahlberg, has stated: ‘Caffraria means South East Africa’. My investigation does not exclude the possibility that *kinbergi* was collected near the *reichei* type locality as suggested by Zicsi (1998), but does not confirm this. The other acanthodriline species *Parachilota wahlbergi* (Michaelsen, 1899*a*), also recorded in Wahlberg’s collection as collected in ‘Caffraria’, is known from Gauteng, Mpumalanga and KZN.

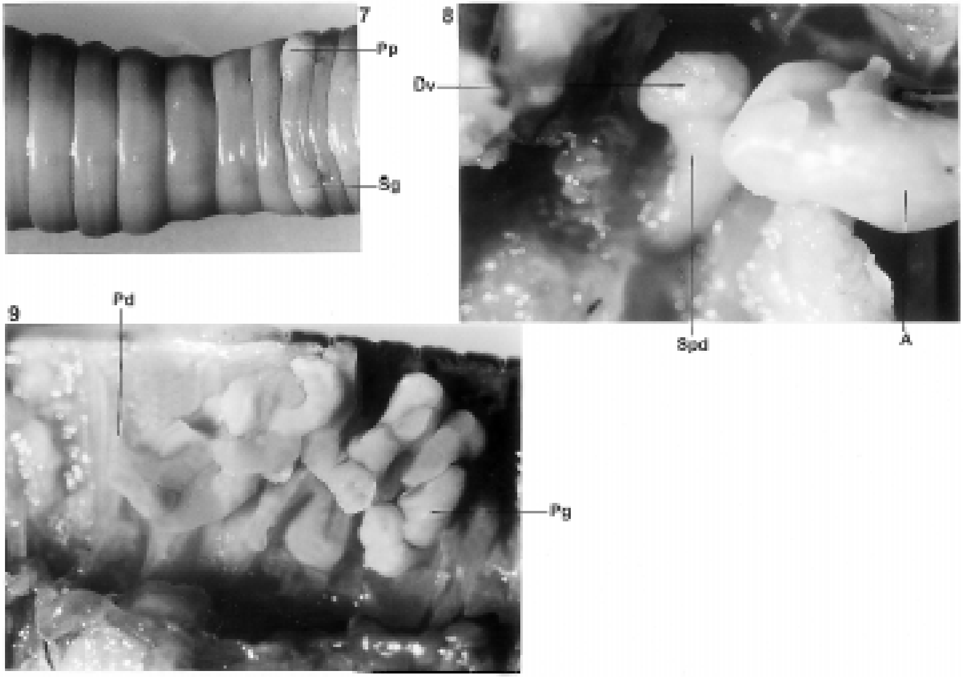
Udeina mapelane sp. n.

Figs 7–9

Etymology: Named after the type locality Mapelane Nature Reserve, an African place name in apposition.

Type material: Holotype: clitellate NMSA/Olig.03881 *KwaZulu-Natal*: Mapelane Nature Reserve (28°26'S:32°24'E) coastal forest, at forest outskirts, sandy soil with thick layer of black topsoil, 14 May 1997, JDP. Paratypes: collected together with holotype NMSA/Olig.03882, 9 cl; NMSA/Olig.02563, 6 cl + 23 juv; Grid 5, NMSA/Olig.02561, 2 specimens with brown cl + 3 juv; Grid 3 NMSA/Olig.02562, 3 cl + 11 juv. Other material: Mapelane Nature Reserve, forest disturbed for more than 30 years, material collected by workers of Pretoria Mammals Research Institute, in pitfall traps below surface layer, 26 August 1996: Grid 1, NMSA/Olig.02522, 1 cl; Grid 2, NMSA/Olig.02523, 8 cl; Grid 3, NMSA/Olig.02525, 1 clitellate + 1 juv; 26–30 August 1996, Grid 5, NMSA/Olig.02517, 1 cl & NMSA/Olig.02526, 1 cl. Mapelane Nature Reserve, indigenous coastal forest (Zulti-North) undisturbed for over 37 years, 26–27 August 1996: Grid 1, NMSA/Olig.02502, 1 cl & NMSA/Olig.02507, 1 cl; Grid 5 in pitfall traps located in litter, NMSA/Olig.02506, 6 cl + 2 juv & NMSA/Olig.02508, 1 cl.

Additionally, 12 samples of this species collected also in the Mapelane Nature Reserve by workers of the Mammal Research Institute were examined, but due to their poor preservation were not taken into the Natal Museum collection.



Figs 7–9. *Udeina mapelane* sp. n. Paratype. 7. External ventral area of segments 10–20, 80 X; figures refer to segments: Pp = prostatic pore; Sg = seminal groove. 8. Right spermatheca. A = ampulla; Dv = diverticulum; Spd = spermathecal duct. 9. Prostate. Pg = prostatic gland; Pd = prostatic duct.

Description:

External features:

Body cylindrical, in life dorsally dark violet, iridescent; alcohol-preserved dorsally violet, anteriorly extending pigmentation to *c* setal lines, posteriorly to *d* setae; ventrally yellowish-grey. *Dimension*: holotype 120 mm long, 5 mm wide; mature specimens 89–123 mm long, 4–6 mm wide. *Segment number*: holotype 165; paratypes 120–174. *Prostomium*: tanylobous, narrow, with well-marked sutures. *Setae*: widely paired, *aa* > *bc*; *ab* < *bc*; *ab* < *cd*; *Dorsal pores*: not observed. *Nephridial pores*: not observed. *Spermathecal pores*: in intersegmental furrow 7/8, in front of *b* setae, in small swellings. *Female pores*: paired, in 14, posteriorly to *b* setae. *Clitellum*: saddle-shaped, with thick layer of yellow-white tissues on 13–17; on mature individuals distinctly marked anteriorly and posteriorly; on some mature individuals marked by brownish colouration, with no clitellar tissues externally. *Prostatic pores*: one pair close to *b* setae, on papillae in segment 17. *Male pores*: medially to *b* setae, in ecliptic depressions in segment 18. *Seminal grooves* (Fig. 7): deep, straight furrows between prostatic and male pores, widened at connection with male pores. *Papillae*: small rounded swellings on 14, 15, 16 encircling *a* setae.

Internal characters:

Salivary glands: large, extending backward beyond septum 4/5, covering large part of gizzard. *Gizzard*: well developed, in segment 5, cylindrical, muscular. *Septa*: 6/7–11/12 increasing in thickness, 12/13–15/16 decreasing. *Intestine*: commences in 16.

Lateral hearts: last pair of hearts in 12. *Nephridia*: moderate loops without terminal vesicles. *Ovaries*: large, cluster-shaped, in 13. *Testes* and *spermiductal funnels*: spermiductal funnels large, free, ventrally in segment 10. *Vasa deferentia*: well developed; at each side of the body a single duct commences in segment 10 and runs backward, entering male pore in segment 18. *Seminal vesicles*: two pairs; in 9 and 11; both pairs lobular, anterior smaller then posterior. *Spermathecae* (Fig. 8): in segment 8. Ampulla large, ovoid. Duct nearly as long as ampulla, entering body wall in intersegmental furrow 7/8. Diverticulum unilobate, globular, iridescent, attached laterally to duct below joint ampulla/duct. *Prostates* (Fig. 9): one pair in segments 17–23. Prostatic gland multi-folded, looped, passing irregularly backwards through segments 18–23; thin septa of occupied segments partly pierced by looped prostatic gland. Prostatic duct connected with prostatic gland by thin, soft tube at posterior part of segment 17, becomes elongated, looped, and thick where enters prostatic pores in segment 17. *Penial setae*: *a* and *b* well developed, supported by muscles of segments 16/17. *Penial setal retractor muscles*: commence at septum 16/17.

Biological notes and distribution: Mapelane Nature Reserve is located in coastal southern Zululand, south of Lake St. Lucia estuary, on the south bank and at the mouth of the Mfolozi River. The dense coastal dune forest extends nearly 9 km southwards from the river mouth and separates the inland floodplain and the sea. Much of the indigenous forest with unique vegetation has been under protection for over 100 years. The adjacent forested area not falling under protection, but also retaining some indigenous trees and bushes, has been used for wood production, although soil and litter were not much devastated. In August 1996, staff of the Mammal Research Institute, University of Pretoria, compared collections of litter and soil-fauna from disturbed and pristine areas. The earthworms were caught in pitfall traps placed in the litter and in the first layer of the topsoil. The new species *U. mapelane* was collected in both forested parts, but more were trapped in the less disturbed area. A similar earthworm collection was obtained in May 1997 by digging in undisturbed parts of the indigenous forest. An abundant population of *U. mapelane* was observed in the soil and litter. It is noteworthy that within *Udeina* this is the only species found in such large numbers, suggesting that it prefers organically rich, undisturbed soils.

The species was collected in May and August, locally the beginning and middle of the winter; a mild climate is characteristic of the coastal area. Abundant occurrence of fully matured individuals, juveniles, and specimens in post sexual-states at the time of collecting suggests activity during the whole year.

Discussion: This species, having prostatic pores in segment 17, male pores in 18, commencing intestine in 16, and having the last pair of hearts in 12, is closely related to *U. pliskoae.* They differ in two substantial characters. Spermiductal funnels are enclosed in *U. pliskoae,* but they are free in *U. mapelane*. The size and shape of the whole spermatheca differ. In *U. mapelane* the length of the spermathecal duct is much longer than in *U. pliskoae.*

Udeina montanus Pickford, 1937

Udeina montanus Pickford, 1937: 420; Reynolds & Cook 1976: 140.

Material examined: Paratypes No. SAM 137 (South African Museum, Cape Town), *Western Cape*: Langeberg, Cogman’s Kloof, two tubes: one containing 4 clitellate +

2 juvenile; the second tube with one clitellate, dissected. All specimens decomposed, in poor condition. Pickford (1937: 420) stated: ‘no data, or collector name; in alcohol, [specimens] in very poor preservation’.

Remarks: Paratype material is heavily decomposed, although the balantine arrangements of the male reproductive organs can be traced. The shape of the spermathecae and prostates are recognisable and are in accordance with Pickford’s description. The position and fusion of the prostatic duct and male pore cannot be confirmed. The description by Pickford, however, is comprehensive.

Udeina nkandla sp. n.

Figs 10–12

Etymology: Named after the type locality Nkandla Forest Reserve, an African place name in apposition.

Type material: Holotype: clitellate NMSA/Olig.03533 *KwaZulu-Natal*: Nkandla Forest Reserve (28°42'43.959"S:31°08'38.991"E), east facing slope at approx. 1204 m, under grass burnt three years ago, from soil at 30 cm depth, 21 November 2001, A. J. Armstrong & H. Murray. Paratype: NMSA/Olig.03619, 1 abscised juvenile collected together with holotype.

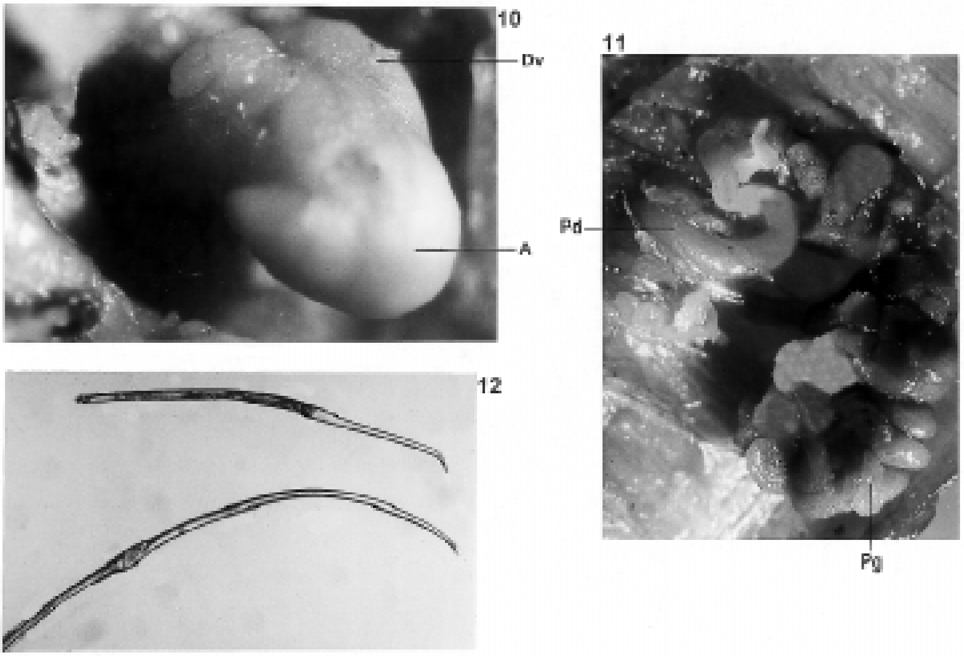
Description:

External features:

Body cylindrical, in life and freshly alcohol-preserved, dorsally violet up to middle of body length; last four segments pigmented circularly; ventrally yellowish-grey. Colouration fading after two years preservation. Holotype 66 mm long, 4 mm wide. *Segment number*: holotype 142; abscised juvenile 94. *Prostomium*: tanylobous with distinct sutures. *Setae*: relatively large, widely paired; at 15–16 distance between *ab* setae decreasing, on 18–21 increasing; postclitellarly $ab < cd$, $aa = bc$. *Dorsal pores*: not observed. *Nephridial pores*: not observed. *Spermathecal pores*: in intersegmental furrow 7/8 in front of *b* setae, on small, elongated swellings. *Female pores*: paired, in intersegmental furrow 13/14, in front of *a* setae. *Clitellum*: saddle-shaped, on 13–17; ventral edges extending to *b* setal lines. *Prostatic pores*: one pair in 17, in small, elongated swellings encircling *b* setae. *Male pores*: externally not observed, probably in 17/18 as suggesting by ectal parts of vasa deferentia. *Seminal grooves*: not observed. *Papillae*: paired, small, elongated, on 19 and 20, below *a* setae.

Internal characters:

Salivary glands: very short, not extending backwards beyond septum 4/5. *Gizzard*: in 5, well developed, cylindrical, muscular. *Septa*: 5/6–7/8 thin, 8/9–10/11 increasing in thickness, although not muscular, 11/12–14/16 decreasing; other septa thin. *Intestine*: commences in 16. *Lateral hearts*: four pairs, last pair in 12. *Nephridia*: large, elongated coiled loops without terminal vesicles, larger in anterior segments; posteriorly much smaller. *Ovaries*: large funnels in 13, medially, close to intersegmental furrow 13/14. *Testes* and *spermiductal funnels*: spermiductal funnels free, iridescent, medially in 10. *Vasa deferentia*: commencing in 10, extending into 11, then covered by thick tissues of body wall; noted again in 16–17 and in posterior part of segment 17, possibly entering in intersegmental furrow 17/18 behind prostatic pores; ectal parts covered by wall tissues. *Seminal vesicles*: two pairs; in 9 and 11,



Figs 10–12. *Udeina nkandla* sp. n. Holotype. 10. Right spermatheca, 400 X. A = ampulla; Dv = diverticulum; 11. Right prostate, 400 X. Pg = prostatic gland; Pd = prostatic duct; 12. Ectal parts of penial setae, 500 X.

both pairs well developed, large, lobulate. *Spermathecae* (Fig. 10): in segment 8 with ectal parts entering body wall in intersegmental furrow 7/8. Ampulla large, width nearly twice length, irregularly oval; duct initially thin, widening sharply at connection with ampulla. Diverticulum bilobate, attached to anterior face of duct, terminating below duct's connection with ampulla. *Prostates* (Fig. 11): one pair, moderate in size in 17–20. Prostatic gland, multi-folded, looped, passing irregularly backwards and forwards through segments 19–20–19; thin septa of occupied segments partly pierced. Duct soft, coiled in segment 18, in 17 muscular, evidently entering into pore in segment 17. *Penial setae* (Fig. 12): two setae in bunch, both poorly developed; entally straight, ectally curved; *a* and *b* differ slightly at ectal parts, being rounded or sharpened. *Penial setal retractor muscles*: commence at septum 18/19.

Biological notes and distribution: This species was collected from patches of grassland on the eastern slope of a forested area, at about 1200 m, in the Nkandla Forest Reserve located in central KZN, under protection of Ezemvelo KZN Wildlife. Much of the reserve is forested; however, various short grasses occur at the forest margins, and some areas are regularly burned to provide grazing for cattle. The clitellate specimen and one juvenile were found at 30 cm, under grass roots recovering after being burnt. Associated with microchaetid species *Proandricus babanango* Plisko, 1992 and *Tritogenia tetrata* Plisko, 2003.

Discussion: *U. nkandla* differs from other known congeners in having prostatic pores in segment 17, male pores in intersegmental furrow 17/18, female pores in intersegmental furrow 13/14, and spermathecal bilobate diverticulum.

Udeina petrosi sp. n.

Figs 13–15

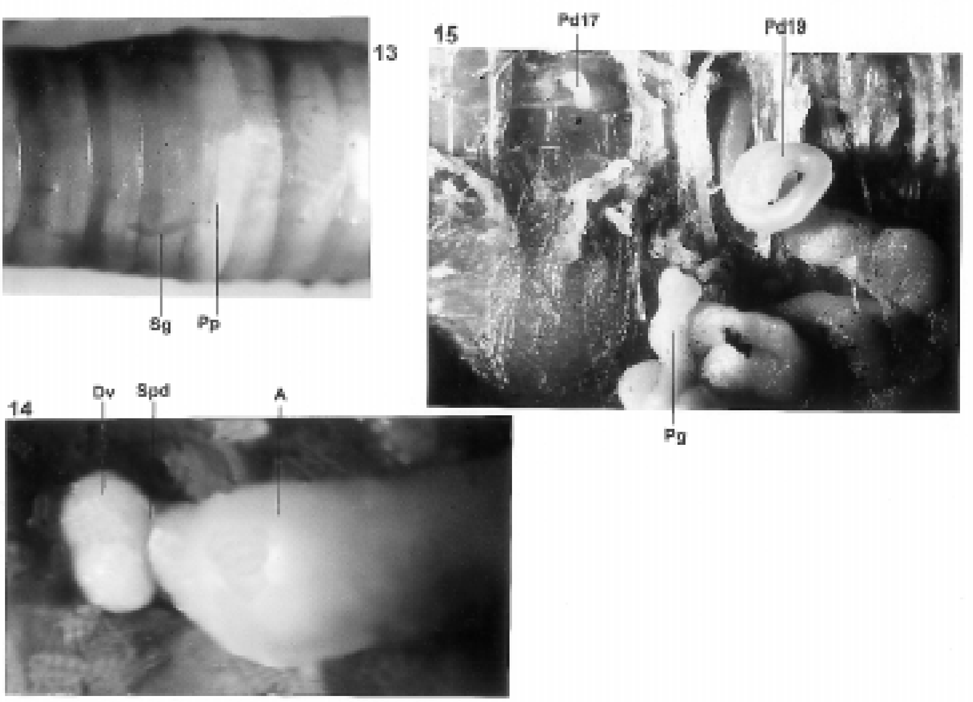
Etymology: Named after Mr Petros Ngwenya of Ezemvelo KZN Wildlife, who assisted in collecting the type material.

Type material: Holotype: clitellate NMSA/Olig.03371 *KwaZulu-Natal*: Highmoor State Forest (29°18'33"S:29°35'54"E), grassland at the edge of marsh, in moist soil, 14 March 2001, JDP, A. J. Armstrong, P. Ngwenya. Paratypes: NMSA/Olig.03616, 7 clitellate; NMSA/Olig.03617, 7 juvenile; all collected with holotype.

Description:

External features:

Body cylindrical, in life dorsally violet, ventrally yellowish-grey; alcohol-preserved dorsally violet, with stronger tint on preclitellar segments; ventrally yellowish-gray. Clitellate 90–128 mm long, 4 mm wide. *Segment number*: holotype 160; clitellate paratypes 158–166, aclitellate 117–161. *Prostomium*: tanylobous with evident sutures. *Setae*: widely paired; on postclitellar segments *aa* < *bc*; *ab* < *cd*. *Dorsal pores*: not observed. *Nephridial pores*: on holotype not observed; on two paratypes noted in *b* setal lines in intersegmental furrow 21/22, and in selected posterior furrows. *Spermathecal pores*: in intersegmental furrow 7/8, in front of *b*. *Female pores*: paired



Figs 13–15. *Udeina petrosi* sp. n. Paratype. 13. External ventral area of segments 15–21, 90 X. Pp = prostatic pore; Sg = seminal groove. 14. Spermatheca, 380 X. A = ampulla; Dv = diverticulum; Spd = spermathecal duct. 15. Prostate of segment 19 and vestigial prostatic duct of segment 17. Pg = prostatic gland of segment 19; Pd19 = prostatic duct of segment 19; Pd17 = vestigial prostatic duct of segment 17.

in 14, in front of *b* setae. *Clitellum*: saddle-shaped, on 13–1/n18; anterior border at intersegmental furrow 12/13, clitellar tissue on segment 13 slightly thinner than on 14–17; posterior border on 1/n18; lateral edges extend to rows of papillae in zigzag lines, bordering papillae located on 13–17. *Prostatic pores*: one pair in small round papillae encircling *b* setae, in segment 19. *Seminal grooves* (Fig.13): paired, longitudinal slightly curved, between posterior part of 17 and prostatic pore of 19; in 18 noted small depression being male pore. *Male pores*: paired, small openings in 18, lateral to *b* setae; indicated by vas deferens entering body wall behind *ab* setae, posteriorly to 17. *Papillae*: paired, below *b* setae, parallel with ventral clitellar borders on segments 13–17; small swellings, oval, flat. It is not known if papillae of 17 support ectal prostatic ducts of the evidently reduced prostates of segment 17.

Internal characters:

Salivary glands: not extending beyond septum 4/5. *Gizzard*: well developed, in 5, muscular, cylindrical with anterior soft fold. *Septa*: 5/6–6/7 thin, 7/8–12/13 increasing in thickness, muscular, 13/14–15/16 thinner; some variations in thickness in dissected individuals were observed. *Intestine*: commences in 16. *Lateral hearts*: four pairs, thin vessels, last pair in 12. *Nephridia*: large elongated coiled loops without terminal vesicles, posterior smaller. *Ovaries*: large funnels attached to intersegmental furrow 13/14. *Testes* and *spermiductal funnels*: spermiductal funnels large, free, medially in segment 10, iridescent. *Vasa deferentia*: one pair; anteriorly covered by thick tissues of body wall, run backwards parallel to axis of the body to 15, where become evident as single, soft tube, extending to posterior part of 17, and entering into body wall. In majority of dissected paratypes, after passing vestigial parts of muscular ducts of the reduced prostatic gland of segment 17, run backwards and enter into body wall near intersegmental furrow 17/18. It is, however, not known if posterior part of vas deferens enters into well-marked externally small depression in intersegmental furrow 17/18, or extends into noticeable depression in 18 that might be male pore. *Seminal vesicles*: two pairs; in 9 and 11, differing in size; in 9 very small, laterally attached to 9/10; in 11 larger, connected at septum 10/11, composite sacs extending dorsally. In dissected paratypes some variations in size and shape were observed, which might be due to different states of individual maturity. *Spermathecae* (Fig. 14): one pair in segment 8. Ampulla elongated, connected with duct above diverticulum. Duct moderately thick with ectal parts entering body wall in intersegmental furrow 7/8; short, not longer than $\frac{1}{4}$ of the length of ampulla. Diverticulum attached at basal region of spermathecal duct, much smaller than ampulla, variable shapes and folds indicating two partially separated divisions. *Prostates* (Fig. 15): one well-developed pair in 19, and one pair of small, vestigial prostatic ducts in 17; ectal openings in 17 not confirmed. Prostatic duct in segment 19 muscular, coiled or looped several times in the same segment, extending backwards into 20, evidently entering prostatic pore in segment 19. Prostatic gland much thicker than duct, multi-folded, looped, passing irregularly backwards and forwards through segments 18–23; septa are pierced, or only conically extended. The rudimentary ducts of segment 17 differ in size and states of development, being however similar to ectal parts of ducts in segment 19, in six dissected individuals. These vestiges can occur paired, or single, either at left or right side of the body, but occur only in segment 17. *Penial setae*: *ab* setae of segment 19 transferred into penial setae. Differ in size, being probably in different states of development. *Penial setal retractor muscles*: commence at septum 18/19.

Biological notes and distribution: This species was collected in moist grassland soil, at edge of muddy depression, in the foothills of Drakensberg escarpment. Associated with the microchaetid *Proandricus bergvillensis* Plisko 2000, and other acanthodrilines of the genus *Parachilota*.

Discussion: A distinctive species, having in addition to the well-developed prostates in segment 19, the additional pair of vestigial parts of the prostatic ducts in 17. No developed prostatic glands in 17. These vestigial ducts may suggest reduction of the anterior pair of prostates, which are present in the species of the sister genus *Parachilota*. The spermathecal diverticulum is small, attached to the basal region of the spermathecal duct, with partially separated divisions, variable in size.

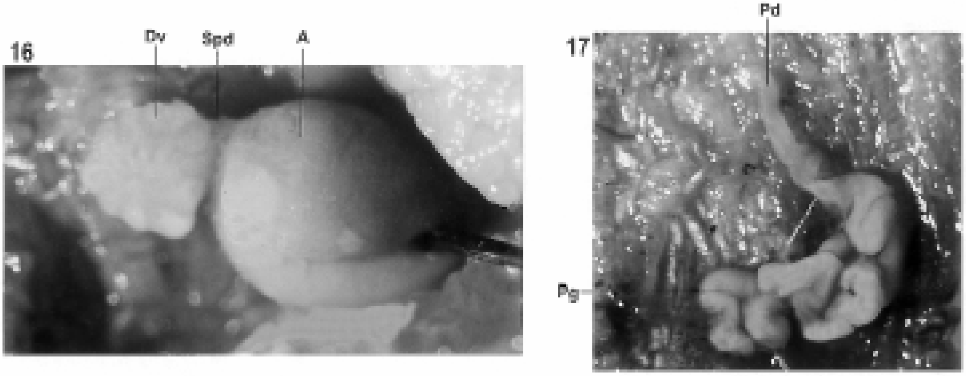
Udeina pliskoae Zicsi, 1998

Figs 16–17

Udeina pliskoae Zicsi, 1998: 68.

Material examined: Holotype NMSA/Olig.00729, and one immature paratype NMSA/00729a, both collected in *KwaZulu-Natal:* Eastwolds (30º00'S:29º55'E) area, approx. 30 km north-west of Ixopo, along road to Bulwer, 29 January 1991, JDP & B.R. Stuckenberg; clitellate, holotype dissected.

Remarks: External and internal characters accord with the original description. Additional data are as follows: prostatic pores in segment 17 on small rounded papillae; male pores in front of *b* setae evident in 18. Vasa deferentia extend to segment 18, entering body wall separately from prostatic duct. Spermathecae in segment 8, spermathecal ducts entering into intersegmental furrow 7/8. Spermathecal duct short; spermathecal diverticulum chambered, unilobate (Fig. 16), iridescent, containing sperm. No sperm were observed in duct or in ampulla. Prostate (Fig. 17) elongated in segments 16–19. *U. pliskoae* is similar to *U. mapelane*, differing in two substantial characters. In *U. pliskoae* spermiductal funnels are enclosed, but they are free in *U. mapelane*; the size and shape of the whole spermathecae, and notably the length of spermathecal duct in *U. mapelane* which is much longer than this in *U. pliskoae*. The similarity between *U. pliskoae* and *U. reichei* indicated by Zicsi (1998) cannot be confirmed. These species differ also notably in the shape of spermathecae and prostate (Figs 16–17, 21–23).



Figs 16–17. *Udeina pliskoae* Zicsi, 1998. Holotype. 16. Spermatheca, 500 X. A = ampulla; Dv = diverticulum; Spd = spermathecal duct. 17. Prostate. Pg = prostatic gland; Pd = prostatic duct.

Udeina qudeni sp. n.

Figs 18–20

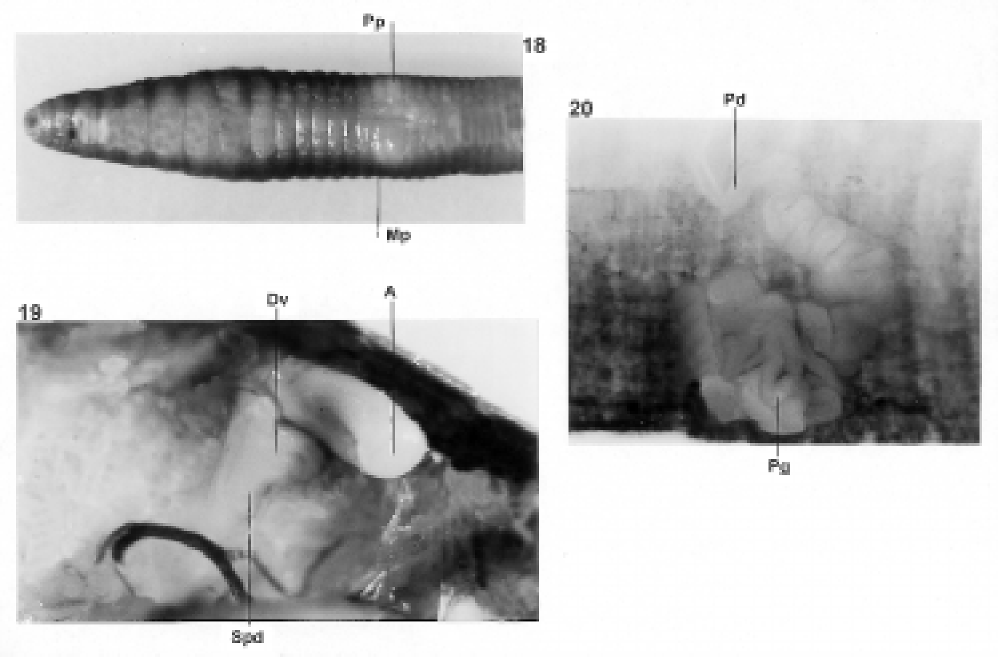
Etymology: Named after the type locality Qudeni Forest Reserve, an African place name in apposition.

Type material: Holotype: clitellate NMSA/Olig.03770 *KwaZulu-Natal*: Qudeni Forest Reserve (28º37'1.557"S:30º50'19.526"E), hillside, grassland, under rock, 4 March 2003, A. J. Armstrong.

Description:

External features:

Body cylindrical, alcohol-preserved dorsally violet, iridescent, colouring fading posteriorly; laterally extending to setal lines *a*; five anterior segments circularly pigmented; ventrally yellowish-grey. Holotype abscised 19+ mm long, 2 mm wide. *Segment number*: 62+. *Prostomium*: tanylobous, narrow, elongated, with distinct sutures. *Setae*: widely paired, moderately large, at segment 20 *aa* > *bc*; *ab* < *cd*. *Dorsal pores*: not observed. *Nephridial pores*: not observed. *Spermathecal pores*: in intersegmental furrow 7/8, in front of *b* setae, in small swellings. *Female pores*: not observed. *Clitellum*: saddle-shaped, on 13–17 marked by reddish-brown colouration. *Prostatic pores* (Fig. 18): on small papillae in 17. *Male pores*: in 16, in papillae. *Seminal grooves*: not observed. *Papillae*: tiny swellings, posterior to *b* setae on segment 9.



Figs 18– 20. *Udeina qudeni* sp. n. Holotype. 18. Anterior part ventrally, 80 X. Pp = prostatic pore; Mp = male pore. 19. Spermatheca, 350 X. A = ampulla; Dv = diverticulum; Spd = spermathecal duct. 20. Prostate, 400 X. Pg = prostatic gland; Pd = prostatic duct.

Internal characters:

Salivary glands: small, not extending backwards beyond septum 4/5. *Gizzard*: well developed, in segment 5, elongated, muscular. *Septa*: 5/6–7/8 slightly thickened, those following not thickened. *Intestine*: commences in 15. *Lateral hearts*: four pairs, last pair in 12. *Nephridia*: tiny loops without terminal vesicles. *Ovaries*: not observed. *Testes* and *spermiductal funnels*: spermiductal funnels small, free, ventrally in segment 10. *Vasa deferentia*: covered by thick tissues of body wall; ectal parts not observed. *Seminal vesicles*: two pairs; in 9 and 11, anterior pair much smaller then posterior. *Spermathecae* (Fig. 19): in segment 8. Ampulla oblong, elongated, bent forwards over duct and diverticulum. Duct stretched out, nearly as long as ampulla, ectal parts entering body wall in intersegmental furrow 7/8. Diverticulum moderate in size, globular, unilobate, attached to duct below ampulla. *Prostates* (Fig. 20): one pair in segments 17–20. Prostatic gland multi-folded, looped, passing irregularly backwards through segments 18–20; thin septa of occupied segments partly pierced. Prostatic duct thin, soft, elongated, connected with prostatic gland in posterior part of segment 17, evidently entering into prostatic pores in segment 17. *Penial setae*: *a* and *b* similar, undeveloped probably due to the post-sexual state of the specimen; ectally slightly curved with sharp blade. *Penial setal retractor muscles*: thin, commence posteriorly to septum 17/18.

Biological notes and distribution: The unique specimen was found at a montane site overlooking the Thukela valley, central KZN, in grassland soil. Iridescence observed in the diverticulum suggests previous sexual activity.

Discussion: *U. qudeni* is a distinctive species. It differs notably from congeners in having male pores relocated into segment 16, with prostatic pores in segment 17. The origin of intestine in segment 15 is also a unique character in this genus. It is unknown whether these characters are constant, since only one specimen was found.

Udeina reichei (Ude, 1905)

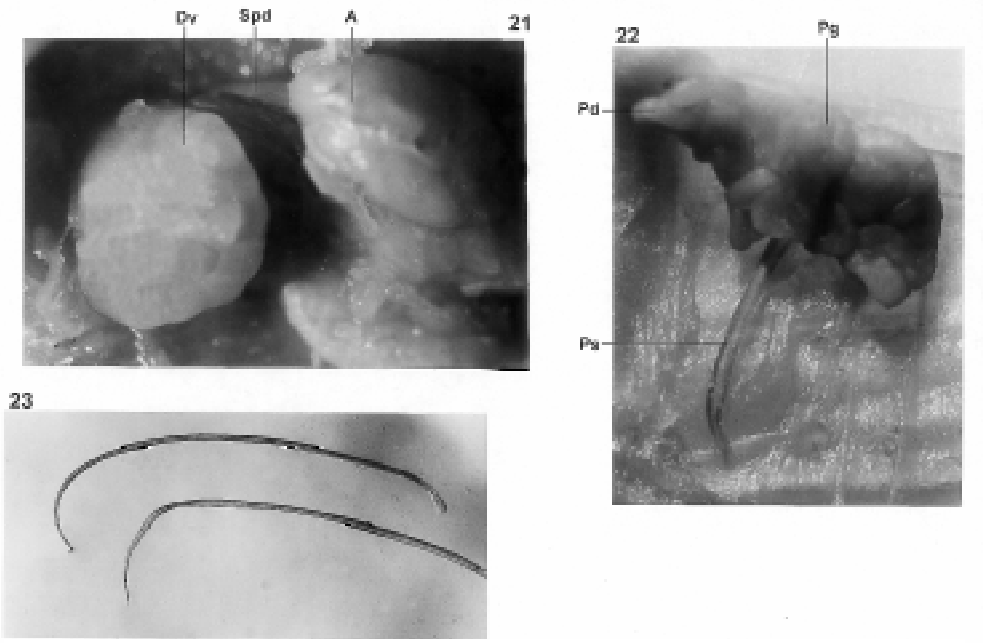
Figs 21–23

Holoscolex reichei Ude, 1905: 421; Reynolds & Cook 1976: 162.
Udeina reichei: Michaelsen 1907: 32, 1912: 4, 5; Zicsi 1998: 68.
Udeina kinbergi [partim]: Pickford 1937: 416.
Udeina kinbergi: Ljungström 1972: 105.

Material examined: NMSA/Olig.01097, 2 clitellate, 7 juvenile, *Free State*: Warrenton, near bank of the Vaal River at motor bridge, in grass, near potato field, 13 March 1967, P. O. Ljungström & A. J. Reinecke.

External features:

Body cylindrical, alcohol-preserved yellowish-grey, clitellate 110–112 mm long, 5 mm wide. *Segment number*: 153. *Prostomium*: tanylobous, clear sutures. *Setae*: preclitellarly *aa* < *bc*; *ab* < *cd*; bc > cd; dd > $\frac{1}{2}$U. *Dorsal pores*: not observed. *Nephridial pores*: not observed. *Spermathecal pores*: in intersegmental furrow 7/8, in small swellings, in front of *b* setae. *Female pores*: paired in 14. *Clitellum*: saddle-shaped, on 13–17, orange-brown, laterally extending to *a* setae. *Prostatic pores*: one pair in segment 18, on papillae. *Male pores*: paired, in 17 on small papillae. *Seminal grooves*: shallow, crescentic depressions between prostatic and male pores. *Papillae*: not observed.



Figs 21–23. *Udeina reichei* (Ude, 1905). 21. Spermatheca, 250 X. A = ampulla; Dv = diverticulum; Spd = spermathecal duct. 22. Prostate, 120 X. Pg = prostatic gland; Pd = prostatic duct; Ps = penial seta. 23. Penial setae.

Internal characters:

Salivary glands: small, not extending backwards beyond septum 4/5. *Gizzard*: in segment 5, cylindrical, soft, slightly muscular. *Septa*: 4/5–5/6 thin, 6/7–12/13 much thickened; the thickest 11/12. *Intestine*: commences in 17. *Lateral hearts*: in 8–13, last pair in 13. *Nephridia*: extended loops without terminal vesicles. *Ovaries*: in 13, rosette-shaped funnels. *Testes* and *spermiductal funnels*: spermiductal funnels free, ventrally in segment 10. *Vasa deferentia*: anteriorly covered by thick tissues of body wall; posteriorly extending through 13–16, entering behind intersegmental furrow 16/17, and into male pores in 17. *Seminal vesicles*: two pairs; in 9 and 11; anterior pair slightly smaller then posterior. *Spermathecae* (Fig. 21): in segment 8. Ampulla large, roughly spherical, attached to duct by wide opening. Duct thick, muscular, nearly as long as ampulla, entering body wall in intersegmental furrow 7/8. Diverticulum attached to duct at its base, knob-like, large, chambered. *Prostates* (Fig. 22): one pair, extending through segments 17–20. Prostatic glands multi-folded, looped, passing irregularly backwards through segments 17–20; thin septa of occupied segments partly pierced where accommodating glands. Prostatic duct soft, elongated, connected with prostatic gland at posterior part of segment 17; evidently entering into prostatic pore in segment 18. *Penial setae* (Figs 22–23): *a* and *b* similar in size and shape. *Penial setal retractor muscles*: thin, commence posteriorly to septum 17/18.

Discussion: The description of the specimens bearing the label '*U. kinbergi*' given by Ljungström (1972) differs from this one, although the presently examined sample has the same locality data given in his paper. Some differences can be attributed to decomposition of material, and the possibility that Ljungström examined other individuals of the sample. Unfortunately, he did not supply any information on external or internal positions of prostate and male pores. From comparative data supplied in his Table 2, it is evident that the material he examined was classified erroneously as *U. kinbergi*. The present examination of specimens from the same sample shows the species to be *U. reichei*.

In the original description, Ude (1905) recorded that the prostatic pores are fused with the male pores in segment 18. However, after a study of initially badly preserved and consequently decomposed *U. reichei* type material, Pickford (1937) reported the independent opening of vas deferens and its entry into the male pore in segment 17, and synonymised *U. reichei* with *U. kinbergi* on this basis. Zicsi (1998) reinstated *U. reichei* and proposed it as the type species for the genus *Udeina*. This, however, was not in accordance with the *International Code for Zoological Nomenclature* (1999), as the genus was monotypic, and material of *U. kinbergi*, although decomposed and difficult to examine, still exists and awaits study.

Udeina stuckenbergi Zicsi, 1998

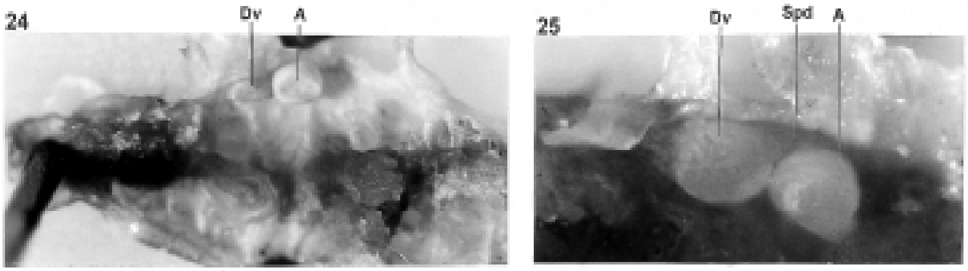
Figs 24–25

Udeina stuckenbergeri Zicsi, 1998: 69 [lapsus calami; Art. 32.5.1 of *International Code of Zoological Nomenclature*, 1999].
Udeina stuckenbergi Zicsi, 1998: 69 [presently corrected].

Material examined: Holotype MNSA/Olig.00536 and two juvenile paratypes NMSA/Olig.02690, *Eastern Cape:* 16 km from Stutterheim (32º32'S:17º29'E) off Road 358, Mr Warren's farm, at approx. 1000 m, on bank of small stream approx. 10 cm depth in moist soil, 19 January 1990, JDP & B.R. Stuckenberg.

Remarks: The external and internal characters accord with Zicsi's description. This species differs notably from congeners in having spermathecae in segment 9, their pores located in intersegmental furrow 8/9, and only one pair of seminal vesicles. Also the shape of spermathecal ampulla and diverticulum are specific (Figs 24–25). The relationships between *U. stuckenbergi* and *U. montanus* are uncertain.

An error in the species name occurred in the original description (Zicsi 1998). The name '*stuckenbergeri*' should have been '*stuckenbergi*'. Zicsi (1998: 69) clearly dedicated the species to Dr B.R. Stuckenberg, Director *emeritus* of the Natal Museum,



Figs 24–25. *Udeina stuckenbergi* Zicsi, 1998. Holotype. 24. Internal view of dissected anterior part with right spermatheca, 250 X. 25. Left spermatheca, 350 X. A = ampulla; Dv = diverticulum; Spd = spermathecal duct.

when he wrote: '*Die neue Art wird zu Ehren des Sammlers Prof. Dr. B.R. Stuckenberg, dem damaligen Direktor des Natalmuseums, benannt*'. In accord with the *International Code of Zoological Nomenclature*, 1999, Art. 32.4 and Art. 32.5, the mistake is corrected here.

DISCUSSION

The genus *Udeina* was not clearly defined when originally established, and this resulted in discussion by various authors (Michaelsen 1899*a*, 1907, 1910, 1912; Ude 1905; Pickford 1937; Gates 1959; Ljungström 1969, 1972; Zicsi 1998). The present study reveals that it should be restricted to the acanthodriline species having the following features: proandry, holonephridia, one pair of spermathecae located in segment 8 or 9, spermathecal pores in intersegmental furrows 7/8 or 8/9, one pair of prostates, with prostatic pores in segment 17 or 18 or 19, and male pores in segment 16 or 17 or 18 or in intersegmental furrow 17/18. The ectal parts of either prostates or vasa deferentia might enter independently into their prostatic or male pores, or might be fused. The tendency to reduction of one pair of prostates, followed by shifting of the pores into anterior or posterior segments, and variable situation of the male pores, are closely associated with proandric conditions, and with the reduction of one pair of spermathecae. It is difficult to decide on the relative systematic predominance of the spermathecal or the prostate conditions: is the reduction of one pair of spermathecae more significant taxonomically than prostatic reduction? Perhaps the proandric condition was linked earlier than reduction of one pair of spermathecae, and prostatic reduction is a subsequent evolutionary development.

Relationships are difficult to establish within *Udeina*. The reduction and relocation of male reproductive organs, especially prostatic pores and male pores, vary interspecifically, although these features are constant within species. Plesiomorphic states that could have been present in ancestral forms might have resembled acanthodriline characteristics, and specialisation could have occurred in *Parachilota*-like lineages.

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